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TESTS WITH MIST BLOWERS TO CONTROL VARIOUS INSECTS

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The tests described herein were conducted during August 1946 in southeastern Virginia and at Beltsville, Md. The main objective of these tests was to determine the effective range of the two mist blowers used in applying the various insecticidal formulations to control the insects involved. Of importance also were the observations on the direct effect of the formulations on the plants to which they were applied by this equipment. The 25-hp. mist blower was mounted on a 1 1/2-ton truck for these tests. It was described by Potts and Friend[2] and was adapted for applying dust and concentrated spray formulations, either separately or both at the same time. The blower delivered about 8,730 cubic feet of air per minute at an outlet velocity of about 124 miles per hour through a short cylindrical discharge pipe 12 inches in diameter. The 1 1/2-hp. portable mist blower, described by Potts and Spencer,[3] was mounted on a wheelbarrow. This blower delivered 120 cubic feet of air per minute at 240 miles per hour through a nozzle 1 1/4 inches in diameter.

The amount of insecticide applied to a given area by the mist blowers is indefinite and can only be estimated. All applications to alfalfa and peanuts with the large mist blower were made from one side of the plot or field, about 1 gallon of spray being used while the machine traveled approximately 50 to 75 feet. In one instance 20 pounds of 2-percent DDT dust was applied to alfalfa while the machine traveled 180 feet along the side of the field. Larger dosages were usually applied to the corn, because most of the areas treated were so planted that the insecticides could be applied from both sides of each plot without damaging the crop with the machine.

1/ The authors are indebted to various specialists in the Division of Insect Identification for all specific determinations referred to in this paper; and to R. A. Spencer, of the Connecticut Agricultural Experiment Station, for valuable assistance in the mechanical phases of the work.

2/ Potts, S. F., and Friend, R. B. Mist blowers for applying concentrated spray. Conn. Agr. Expt. Sta. 501: 47-60, illus. 1946.

3/ Potts, S. F., and Spencer, R. A. A small portable mist blower for applying concentrated spray. U. S. Bur. Ent. and Plant Quar. ET-234, 3 pp. [Processed.] 1947.

Formulations Applied

The following formulations were applied to various crops with the large mist blower (applied as sprays unless otherwise indicated):

1. DDT 1 percent, sulfur 91 percent, inert material 8 percent (dust).
2. DDT 2 1/2 pounds, xylene 3 pints, kerosene to make 5 gallons.
3. DDT 1 1/4 pounds, xylene 1 1/4 quarts, kerosene to make 5 gallons.
4. DDT 2 pounds, xylene 2 1/2 quarts, Triton X-100 (aralkyl polyether alcohol) 5 ounces, plus water to make 4 gallons.
5. DDT 2 1/2 pounds, xylene 3 pints, No. 10 motor oil 8 quarts, kerosene to make 4 gallons.
6. DDT 3 pounds, xylene 3.6 quarts, kerosene to make 3 gallons.
7. DDT 5 pounds, xylene 6 1/4 quarts, No. 10 motor oil 4 quarts, kerosene to make 5 gallons.
8. DDT 5 pounds, xylene 6 1/4 quarts, Triton X-100 12 ounces, water to make 5 gallons. (Also applied to corn with small mist blower).
9. DDT 5 pounds, xylene 6 quarts, Igepal CA (a polyether alcohol condensate) extra high concentrate 12 ounces, water to make 5 gallons.
10. DDT 2 percent in pyrophyllite (dust).
11. DDT 2 pounds, xylene 2 1/2 pints, Vatsol O.T. (dioctyl sodium sulfosuccinate) 2 ounces, water to make 2 gallons.
12. Lead arsenate (dust).
13. DDT 1 pound, xylene 1 1/4 quarts, Triton X-100 2 ounces, water to make 6 quarts.
14. Lead arsenate dust 3 pounds, applied at same time as spray containing lead arsenate 3 pounds, linseed oil 10 ounces, No. 10 motor oil 5 ounces, water to make 6 quarts.
15. Lead arsenate dust 6 pounds, applied at same time as spray containing linseed oil 3 pints, No. 10 motor oil 1/2 pint, Triton X-100 3 ounces, water to make 3 gallons.
16. DDT 8 ounces, xylene 5 pints, kerosene to make 6 quarts.
17. DDT 1 pound, xylene 5 pints, kerosene to make 6 quarts.
18. DDT 2 pounds, xylene 5 pints, kerosene to make 6 quarts; DDT 0.5 pound, pyrophyllite 4.5 pounds applied 3 hours later.
19. DDT 8 ounces, xylene 5 pints, kerosene to make 6 quarts, applied at same time DDT 0.5 pound, pyrophyllite 4.5 pounds.
20. Lead arsenate dust 6 pounds, applied with spray consisting of linseed oil 1.2 pints, No. 10 motor oil 0.6 pint, water to make 6 quarts.
21. Lead arsenate dust 6 pounds, applied with spray consisting of linseed oil 1.5 quarts, No. 10 motor oil 3/4 pint, Triton X-100 3 3/4 ounces, water to make 6 quarts.
22. Benzene hexachloride (10 percent gamma isomer) 10 pounds, linseed oil 2 pints, No. 10 motor oil 1/2 pint, water to make 3 gallons.
23. Chlordan 8 ounces, kerosene to make 6 quarts.
24. DDT 2 pounds, xylene 5 pints, kerosene to make 6 quarts.
25. DDT 8 ounces, xylene 1.2 pints, Triton X-100 1 ounce, water to make 6 quarts.

Tests on Alfalfa and Peanuts

Tests with the large mist blower were conducted primarily to determine whether insecticidal dust mixtures or atomized concentrated-spray formulations could be applied satisfactorily at distances ranging from 50 to 150 feet from the machine to control the potato leafhopper (Empoasca fabae (Harr.)) on alfalfa and peanuts and the corn earworm (Heliothis armigera (Hbn.)) and fall armyworm (Laphygma frugiperda (A. and S.)) on corn. The atomized concentrated sprays were blown and drifted across the field as much as 650 feet in one instance, and some kill of the potato leafhopper on alfalfa was indicated in treated areas at that distance from the machine. As shown in table 1, satisfactory kill of the potato leafhopper was generally obtained on alfalfa and peanuts up to 250 feet from the machine, when emulsions containing as little as 1/4 pound of DDT per gallon were applied. Acknowledgment is made to E. T. Batten and J. M. Grayson of the Tidewater Field Station for assistance with the tests on peanuts at Holland, Va.

The alfalfa treated at Lynnhaven, Va., to control the potato leafhopper was also infested with the pea aphid (Macrosiphum pisi (Kltb.)). Records were therefore made on the effectiveness of the formulations against the pea aphid, as well as against the potato leafhopper. Results of the reduction in populations of the pea aphid following the application of formulas 2, 6, 7, and 8 to alfalfa at Lynnhaven, Va., tabulated in table 2, indicate that satisfactory kill was obtained 250 to 350 feet from the machine. Populations of the pea aphid were estimated by making 20 to 75 sweeps of the net in each area treated, the number being the same for each treatment and its corresponding untreated check. Although the figures given for each individual test in table 2 are based on an equal number of sweeps of the net, between tests the number of sweeps ranged from 20 to 75.

Although not clearly apparent from the data given in tables 1 and 2, it seemed evident as the samples were taken that the insecticides containing DDT reached their full effect against the potato leafhopper within 24 hours after application, but required a longer time to attain their full effect against the pea aphid.

It appeared to be impossible to distribute the insecticide uniformly over the alfalfa at different distances from the machine, as shown by the analyses of air-dried samples for DDT residues given in table 3. A much larger amount of DDT was deposited 50 feet from the machine than at greater distances. In considering the data presented in table 3, it should be kept in mind that applications of insecticides to alfalfa normally would be made 3 weeks or more before the crop is harvested. Although growth of the crop and weathering prior to cutting would greatly reduce the DDT content of the hay made from mature alfalfa under the figures given in table 3, it is possible that the hay still could not be safely fed to livestock. The residue problems involved in the application of atomized concentrated sprays to forage crops remain to be solved. In the meantime the use of these insecticides on forage crops that are to be fed to livestock is not recommended.

Table 1.- Results of tests with a mist blower to control the potato leafhopper.

Formula No.	Pounds of DDT used per gallon	Date (August) Treatment	Date (August) Counts	Leafhopper populations 1/ Untreated	Approximate distance from blower 50ft.	150ft.	250ft.	350ft.	450ft.	550ft.	650ft.
				Tests on peanuts, Holland, Va. 2/							
1	1% dust	6	7-9	26.1	4.8	8.3	11.6				
2	1/2	do	do		0	.3	1.1				
3	1/4				0	.9	3.3				
4	1/2				.3	.3	1.0				
5	5/8				0	0	.5				
				Tests on alfalfa, Lynnhaven, Va. 3/							
2	1/2	5	6	50.0	10.0	75.0	45.0	61.0			
6	1	5	6-13	42.0	0	.3	1.0	.6			
7	1	8	10	113.0	0	1.2	.6	21.2	28.0		
8	1	9	10-13	66.6	.2	.4	13.6	20.0	39.1	16.5	
				Tests on alfalfa, Beltsville, Md.							
9	1	15	19	97.0	0	0	0	0	2.5	19.0	30
10	2% dust	15	19	97.0	3.0	38.0	74.0				

1/ Average of numbers obtained with an insect net 15 inches in diameter; collections of 50 sweeps each.

2/ Average of 2 counts or more.

3/ Average of 3 counts on area treated with formula 6 and of 2 counts on area treated with formula 8.

Table 2.--Results of tests with a mist blower to control the pea aphid on alfalfa at Lynnhaven, Va.

Formula No.	Pounds of DDT used per gallon	Date (August)		Pea aphid populations					
					Approximate distance from blower				
		Treatment	Count	Untreated	50ft.	150ft.	250ft.	350ft.	450ft.
6	1	5	6	1,200	128	176	114	154	---
	---	---	13	1,300	20	53	81	324	---
2 1/	1/2	5	6	1,200	260	-- -	---	700	---
7	1	8	10	77	0	10	31	69	69
8	1	9	13	2,200	10	900	1,200	1,600	1,200

1/ Applied against a wind of 5 miles per hour; satisfactory kill up to 15 feet only.

Table 3.--DDT residues on samples of air-dried alfalfa from areas treated by mist blower 1/ 2/

Formula No.	Date treated (August)	Distance from machine	DDT
		Feet	P.p.m.
Tests at Lynnhaven, Va., samples collected August 10			
6	5	50	206.2
		50	28.8
		150	67.3
		250	36.9
		350	14.7
7	8	50	170.8
		150	46.2
		250	22.7
		350	8.6
8	9	50	303.2
		150	0
		250	11.8
		350	9.2
		450	7.9
		550	2.8 3/
Tests at Beltsville, Md., samples collected August 28			
8	15	50	476.1
		150	84.6
		250	42.6
		350	22.5
		450	20.4
		550	11.4
		650	15.1
10	15	50	17.1
		150	9.4
		250	7.3
		350	1.5

1/ Analyses made by the Division of Insecticide Investigations.

2/ Analyses of untreated checks from both areas gave negative results.

3/ May have been carried by wind from another test conducted in the same field.

Applications to Corn

Both machines were used to apply atomized concentrated sprays to sweet corn to control the corn earworm. The small blower was used in 3 tests to apply formula 8 on August 8 and 13; the large blower was used to apply formula 18 on August 7 and formulas 12, 16, 17, 19, 20, 21, 22, 23, 24, and 25 on August 7 and 12. Satisfactory control of this insect was not obtained with any of these formulas. Examination of 100 to 350 ears of sweet corn from each of the treated plots at harvesttime showed 41 to 99 percent of the ears infested, and the general average was more than 90 percent. On August 22 an examination of 100 ears from the plot treated with formula 21 on August 7 showed 99 infested with the corn earworm. This treatment gave remarkably thorough and uniform coverage of several rows of sweet corn, however, and killed a large number and variety of insects. The orders, and number of species in each order represented, were as follows: Orthoptera 1, Coleoptera 7, Hymenoptera 1, Hemiptera 1, Homoptera 1, Lepidoptera 1, and Diptera 2. Sowbugs were also killed.

Two applications of formulas 6, 11, 12, 13, 14, and 15 to field corn at Norfolk, Va., during the period August 5 to 12 to control the fall armyworm gave unsatisfactory kill of this insect, although mortality of the small larvae was high. This corn was very heavily infested. It was about 24 inches high at the beginning of the treatments. Earlier and properly timed applications may give some measure of economically practical control of this insect.

Applications to Collards

Single applications of a dust containing 10 percent of DDT, of lead arsenate dust, and of concentrated spray formula 11 were made to separate plots of collards at Driver, Va., on August 8 to control the yellow-striped armyworm. Results were inconclusive except that the spray severely damaged the plants up to 35 rows from the machine.

Application to Woodland

On August 3 a planting of mixed pine and hardwood trees at the Virginia Truck Experiment Station was treated with the following emulsion: DDT 6 pounds, Velsicol AR 60 (methylated naphthalene) 7 quarts, Triton X-100 (aralkyl polyether alcohol) 10 ounces, water to make 6 gallons. An estimated area of 6 acres was covered. A large cloth was spread under an oak tree and many insects were down within half an hour after the insecticide was applied. However, most of the species were collected the following morning from the forest floor at various places in the woodland. Approximately 145 species of insects belonging to 57 families and 9 species of spiders belonging to 5 families were collected. The families and number of species in each family represented were as follows:

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Insects:

Anthribidae 1
Arctiidae 3
Asilidae 1
Blattidae 2
Braconidae 2
Buprestidae 3
Calliphoridae 4
Carabidae 10
Cerambycidae 3
Cercopidae 1
Chrysomelidae 11
Chrysopidae 1
Cicadellidae 7
Cicindelidae 1
Citheroniidae 1
Cleridae 1
Coccidae 1
Coccinellidae 1
Curculionidae 7
Dolichopodidae 1
Elateridae 5
Flatidae 1
Formicidae 5
Fungivoridae 1
Gelechiidae 2
Geometridae 2
Gryllidae 2
Ichneumonidae 1
Larvaevoridae 3
Libellulidae 1
Lonchaeidae 1
Lymantridae 1
Miridae 3
Muscidae 7
Notodontidae 7
Nymphalidae 1
Olethreutidae 1
Ostomidae 1
Otitidae 1
Pentatomidae 3
Phalaenidae 3
Pompilidae 2
Sarcophagidae 3
Saturniidae 1
Scarabaeidae 6
Sphecidae 5
Sphingidae 1
Stratiomyidae 1
Sylvicolidae 1
Syrphidae 2
Tabanidae 1
Tendipedidae 1
Tettigonidae 2
Tipulidae 1
Tortricidae 1
Vespidae 2
Zygaenidae 1

Spiders:

Argiopidae 3
Blastobasidae 1
Lycosidae 1
Salticidae 2
Theridiidae 2

Effect on Plants

From the tests described in this paper it seemed evident that DDT-xylene-kerosene mixtures were much more toxic to the plants treated than DDT-kerosene mixtures with the xylene omitted. The DDT-xylene-water emulsions caused no injury. In descending order, collards, alfalfa, and corn were very sensitive to formulations containing aromatic solvents, but this injury can be avoided by a change in the mixture.